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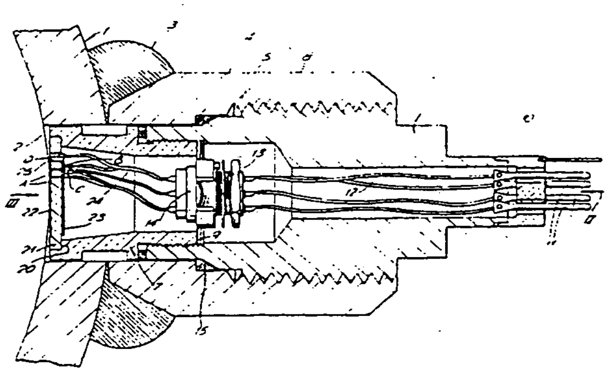
(54) **Electrical resistance corrosion probe.**

(57) A flush mounting electrical resistance corrosion plate for monitoring corrosion of the wall of a vessel or pipeline, having a probe head (7) and body (6), a convoluted strip of the material of the wall as a sample element (22) and reference element (23) being mounted flat in the probe head, the sample element being exposed to the corrosive medium under the same conditions as the wall of the vessel or pipeline and the reference element being subjected to the same conditions of temperature but shielded from the medium. Electrical leads (24) are connected to the elements so that the resistance of the sample element (23) can be monitored and thus the degree of corrosion taking place determined. The convoluted elements are made by a process such as photochemical machining so that they are free of stress.



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ELECTRICAL RESISTANCE CORROSION PROBE

The present invention relates to electrical resistance corrosion probes.

Probes for the testing of corrosion by assessment of electrical resistance have been known for some time. The commonest type - see e.g. GB - A - 2081904 - consists of a stem mounted on the wall of the pipe or vessel the corrosion of which is to be assessed, and projecting into the corrosive medium contained in or flowing in that pipe or vessel. The test element is usually a loop of round wire (see figure 5 of that laid open application) projecting from the end of the stem. the loop is made of the same material as the pipe or vessel. Since it is being subjected to the same corrosive medium as the pipe or vessel, the extent of corrosion of the pipe or the vessel can be assessed by reference to the extent of corrosion of the test loop. This is measured by measuring the variation in resistance of that loop, usually using a bridge circuit. These are means for compensating for temperature variation.

It is a major disadvantage of this type of probe that by their nature they project inwardly from the wall of the vessel or pipe so conditions at the sensing wire may not be the same as those at the wall and particularly in the case of pipelines they have to be withdrawn from the pipe before it can be cleaned or monitored by means of a pig travelling along it. Withdrawal from the pipeline itself is a complex operation.

Furthermore with the probes of this type a large part of the probe stem is itself being exposed to the corrosive medium being tested.

To overcome these disadvantages we provide a flush mounted probe. In this, the sample element is essentially flush with the wall of the vessel or pipe the material of which is being monitored for corrosion. We say essentially

flush because it will not normally be precisely flush but slightly recessed behind the level of the wall so that it will not be damaged by the passage of mechanical elements such as a pig.

The probe sample is in contra distinction to the prior art not a simple loop of wire, but rather a convoluted strip of test material of a length which is many times greater than its width (for example 50 - 200 times, preferably 100 - 150 times) which in turn is many times greater than its thickness (for example 50 - 250 times, preferably 100 - 200 times). A preferred conformation for the sample element is a bifilar (two-start) spiral strip displayed on one surface of a non-corrosive insulating support which is preferably a glass ceramic.

To provide for temperature compensation an exactly similar convoluted element may be provided and be supported at or adjacent the opposite face of the insulating support so as to be shielded from the corrosive material but to be responsive to the temperature conditions obtaining.

It is a particularly advantageous feature of the present invention that to avoid irregular corrosion due to stress in the sample material the convoluted sample may be prepared by an etching process from a flat blank, and the same process may be used for the preparation of the reference at the same time and from the same blank, the reference and sample remaining joined by a bridging link of the material.

The sample and reference element borne on the insulating support preferably form a plug at one end of a probe head which is mounted by means of a separate probe body in an aperture in the wall of the pipe or vessel the corrosion of which is to be monitored. The probe head may be essentially a cylindrical sleeve with the insulating support filling one end and its interior filled with

a plastics material potting or filling, and at its other end having a connection for electrical leads to the sample and reference. The probe body will also be preferably formed as a cylindrical sleeve the outside of which is engagable in fluid tight engagement with a housing associated with the aperture, and is equipped with electrical connection means leading to electrical equipment which is known as such for following these resistance changes. The body may contain a jack or socket for connection with a socket or jack on the probe head so that when it is desired to change the sample, only the probe head needs replacement.

A particular embodiment of the invention will now be described by reference to the accompanying drawings wherein;

Figure 1 is an approximately diametrical section through the embodiment and through a wall of a pipe to which it is mounted

Figure 2 is an end view on the arrow II of figure 1

Figure 3 is an end view on the arrow III of figure 1

Figure 4 shows a sample and reference after etching and before assembly into the probe head.

A wall 1 is of a material, such as steel, of which the corrosion is required to be monitored. This may be the wall of a vessel or as shown here of a pipeline. It has an aperture 2 formed in it around which is welded by seam 3 a hollow carbon steel boss 4 part of which is internally screw threaded at 5.

An electrical resistance corrosion probe can be mounted in the aperture by means of that boss.

The probe has a body 6 and a head 7.

The body 6 is generally cylindrical having external screw threading at 8 for engagement with the screw threading 5 of the boss 4. At its end which is innermost in use it has internal screw threading 9 which is for engagement by external screw threading on the head 7.

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At the outer end of the body there is welded by electron-beam welding a cap 10 through which pass in a fluid tight sealed manner jacks 11 for electrical connection from the probe to the circuitry known as such for following changes in resistance of the sample. The leads 12 pass within the body to a jack 13 which is to engage with a socket 14 at one end of the head 7.

Fluid sealing between the body 6 and the boss 4 is assured by a tapered seal 15 which is compressed between the two as the body is tightened to the boss along the screw threading, using spanner flats 16 (Figure 2) to drive it.

The head 7 is essentially a cylindrical sleeve one end of which has a ledge 20 which positions a support plug 21 formed of a corrosion resistant insulating material such as a glass ceramic. On the flat exposed surface of the glass ceramic there is secured a sample element 22. This is made of the same material as the wall under test. Since it is on the face of the plug 21 it is exposed to the same media as the wall is and under the same conditions as that wall. While we refer to our probe as being "flush mounted", it is in fact slightly inset from the line of the wall so that the exposed element would not be damaged by mechanical abrasion whether due to the material being conveyed or by mechanical elements such as pigs which are passed down a pipeline.

In order to give maxiumum sensitivity to the changes occurring upon corrosion, the element 22 is in the form of a convoluted strip. Its length is many times its width which is many times its thickness (for example its length is 100 times its width and its width is 200 times its thickness). In this way a strip of comparatively high resistance is given which because of its very low thickness (about 0.1 mm) is highly sensitive to changes

by corrosion of one face. The convolution of the strip of course increases the length available within a given aperture in a wall or vessel. A preferred conformation is shown in the element 22 namely a bifilar (two start) planer spiral, though other conformations cen be envisaged.

To provide for temperature-change compensation, a reference element as far as possible identical with the sample element is provided secured to the rear face of the disc 21. This can be seen at 23 figure 1.

Leads 24 are taken from the socket 14 to attachments on the sample and reference elements through the body of the head. This is then filled with a plastics material filling ("potting") such as an epoxy resin so that the head becomes a unitary and highly fluid tight entity. The reference element 23 is protected from corrosive action by the plug 21 but is subjected to substantially the same temperature conditions as the sample 22.

The element and probe head assembly is made by first forming the elements 22 and 23 as a single piece. These are produced by photochemical machining from a blank of the required thickness which may range from 0.1 - 0.2 mm, to give the shape shown in figure 4. The element formed is bent at positions 28 to give the sample element 22 and the reference element 23 joined by a strap 25. To mount the elements in the probe head the element is held in position in the probe head 7 by a jig, and glass ceramic powder is poured into the probe head. The whole assembly is then heated so that the glass ceramic fuses, forming strong bonds with the sides of the probe head and with the sample element. The glass ceramic disc 21 so formed is flush with the end of the probe head and with the exposed surface of the element.

The process such as etching used for making the sample (and reference) element, unlike conventional

machining processes, leaves no residual stresses in the finished component which could lead to localised preferential corrosion. The bends 28 between the two elements are embedded within the glass ceramic disc and thus shielded from the process medium.

The electric leads 24 are permanently connected to the strap 25 and to the free ends 26 and 27 respectively of the sample and reference elements at points A-D in the circuit shown in figure 5. In this way comparative readings may be obtained by per se conventional devices of the resistance at any given time of the resistance of the sample and reference elements and the progress of corrosion thus be monitored.

CLAIMS:

1. An electrical resistance corrosion probe for mounting in a wall of a material the corrosion of which is to be monitored wherein a sample element of that material is in the form of a convoluted elongate member to be mounted flush with the wall.

2. An electrical resistance corrosion probe according to Claim 1 wherein the convolution is a bifilar spiral.

3. An electrical resistance corrosion probe according to Claim 1 or Claim 2 wherein the member is a strip and the length of the strip is from 100 to 150 times its width.

4. An electrical resistance corrosion probe according to Claim 1, Claim 2 or Claim 3, wherein the member is a strip and the width of the strip is from 100 to 200 times its thickness.

5. An electrical resisistance corrosion probe according to any one of the preceding claims wherein the sample element is mounted on one face of an insulating support forming one end of a probe head.

6. An electrical resistance corrosion probe according to Claim 5 wherein the probe head has a hollow shell and is filled with a plastics putting material behind the support.

7. An electrical resistance corrosion probe according to Claim 5 or Claim 6 wherein there is a reference element substantially identical to the sample element, the reference element being mounted inside the probe head behind the insulating support.

8. An electrical resistance corrosion probe according to any one of the preceding claims wherein a substantially strain-free sample element is formed by photochemical machining from a blank.

9. An electrical reistance corrosion probe according to Claim 8 wherein a reference element substantially identical to the sample element is also formed by the

etching process from the same blank.

10. An electrical resistance corrosion probe according to Claim 9 wherein the reference and sample elements remain lined by a strap portion.

11. An electrical resistance corrosion probe according to any one of the preceding claims wherein the sample element is permanently borne by a probe head, the probe head being separately secured to a probe body and the probe body being separately secured to the wall being tested.

CLAIMS

1. An electrical resistance corrosion probe for mounting in a wall of a material the corrosion of which is to be monitored, the probe having a sample element of that material in the form of an elongate member having faces which are wider than its edges, which member is convoluted edge to edge so that a said face thereof essentially provides an overall surface of the convoluted elongate member; the probe being constructed and arranged to mount the convoluted sample element with its said face essentially flush with the wall.

2. An electrical resistance corrosion probe according to claim 1 wherein the convolution is a bifilar spiral.

3. An electrical resistance corrosion probe according to claim 1 or claim 2 wherein the member is a strip and the length of the strip is at least 50 times its width.

4. An electrical resistance corrosion probe according to claim 1 or claim 2 wherein the member is a strip and the length of the strip is from 100 to 150 times its width.

5. An electrical resistance corrosion probe according to claim 1, claim 2 or claim 3, wherein the member is a strip and the width of the strip is from 100 to 200 times its thickness.

6. An electrical resistance corrosion probe according to any one of the preceding claims wherein the sample element is mounted on one face of an insulating support at one end of the probe.

7. An electrical resistance corrosion probe according to claim 5 wherein the probe has a hollow shell behind the insulating support, which hollow shell is filled with a plastics potting material.

8. An electrical resistance corrosion probe according to claim 5 or claim 6 wherein there is a reference element substantially identical to the sample element, the reference element being mounted inside the probe behind the insulating support.

9. An electrical resistance corrosion probe according to any one of the preceding claims wherein a substantially residual stress-free sample element is formed by etching from a blank.

10 An electrical resistance corrosion probe according to claim 8 wherein a reference element substantially identical to the sample element is also formed by the etching process from the same blank.

11. An electrical resistance corrosion probe according to claim 9 wherein the reference and sample elements remain linked by a strap portion.

12. An electrical resistance corrosion probe according to any one of the preceding claims wherein the sample element is permanently borne by a probe head, the probe head being separately secured to a probe body and the probe body being separately secured to the wall being monitored.

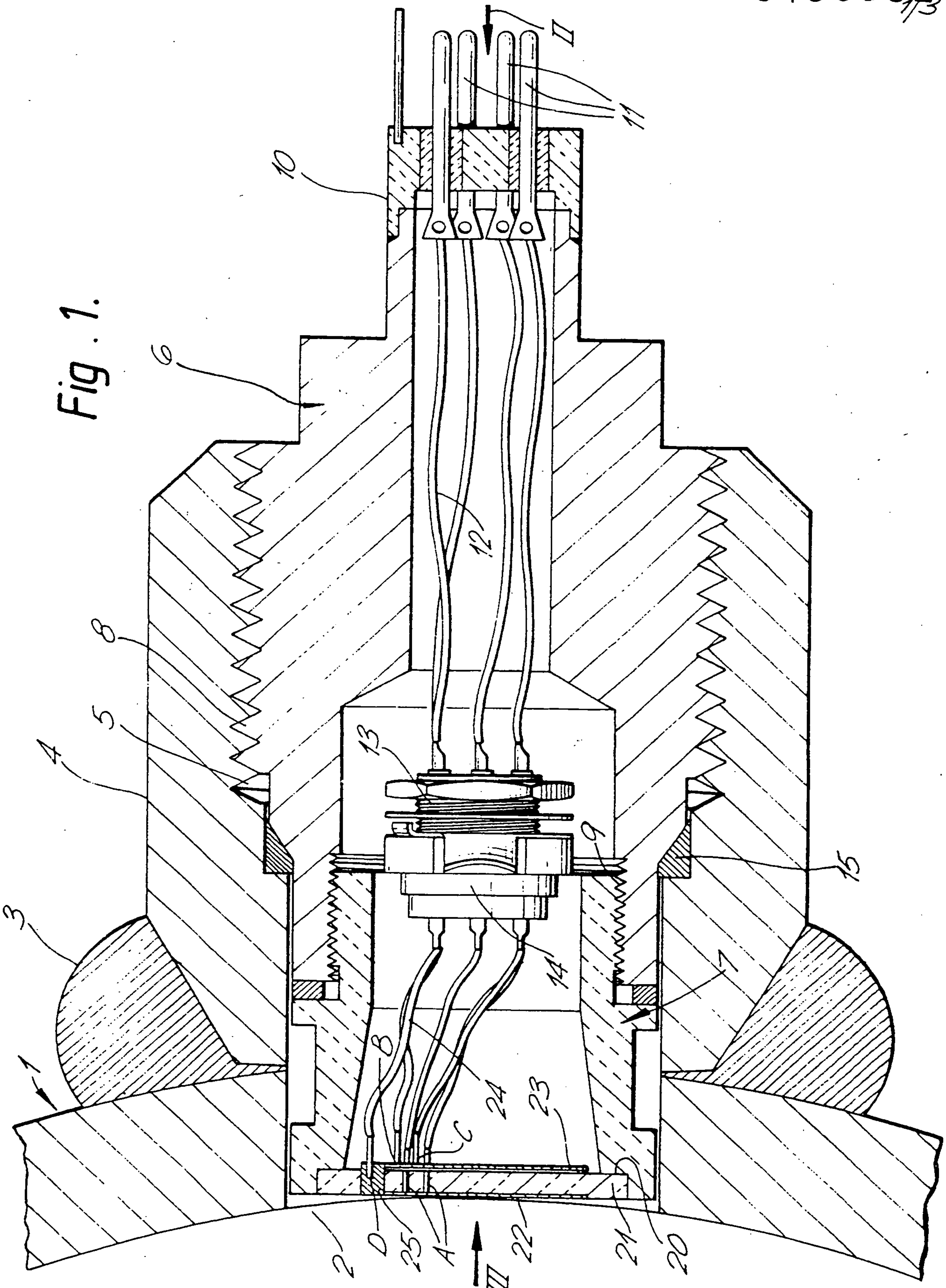


Fig. 1.

Fig. 2.

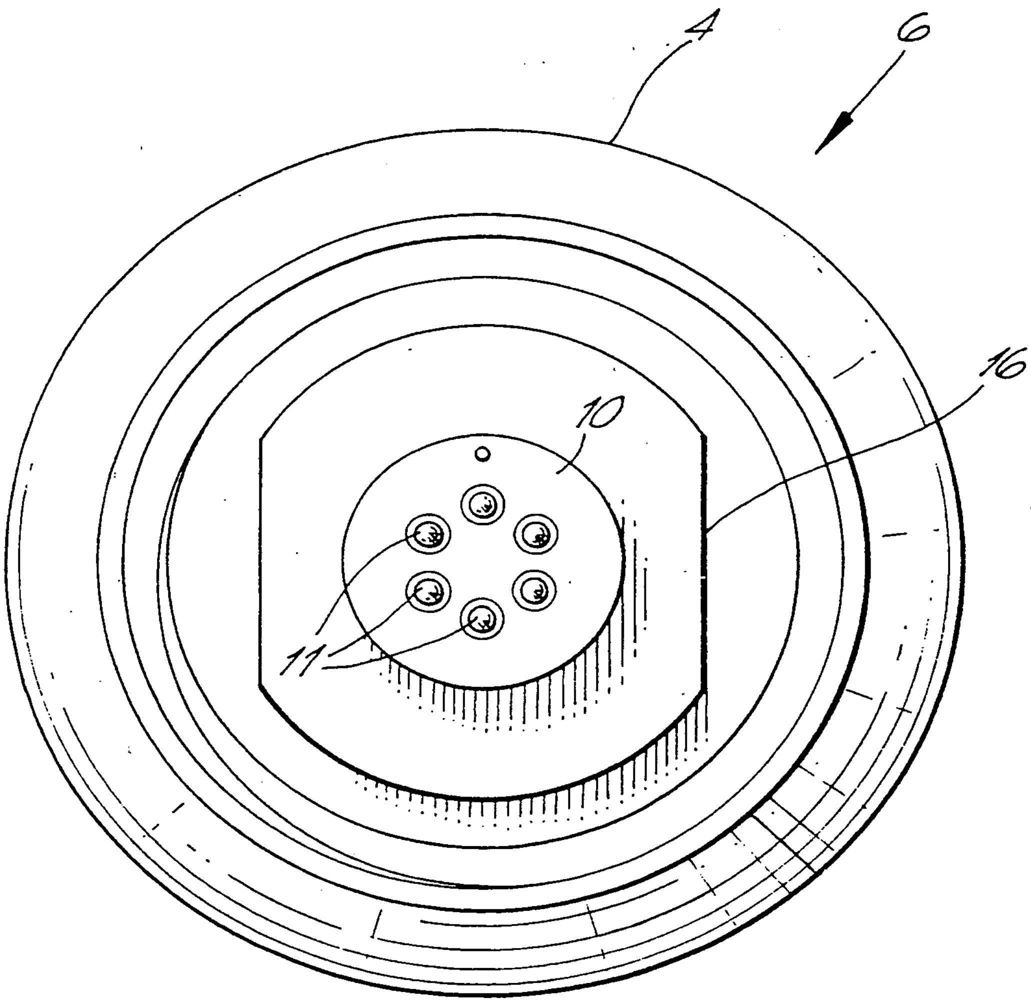


Fig. 5.

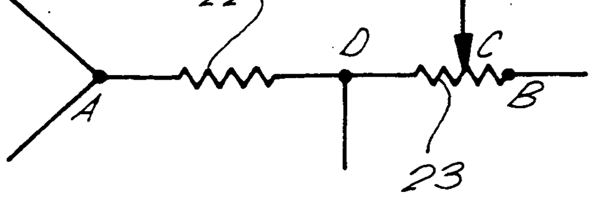


Fig. 3.

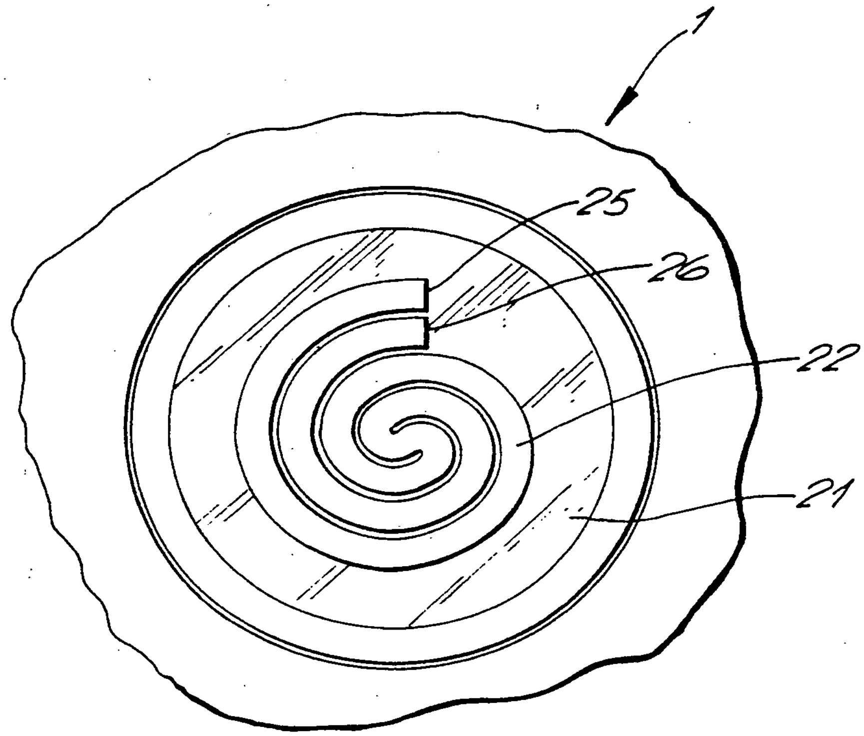
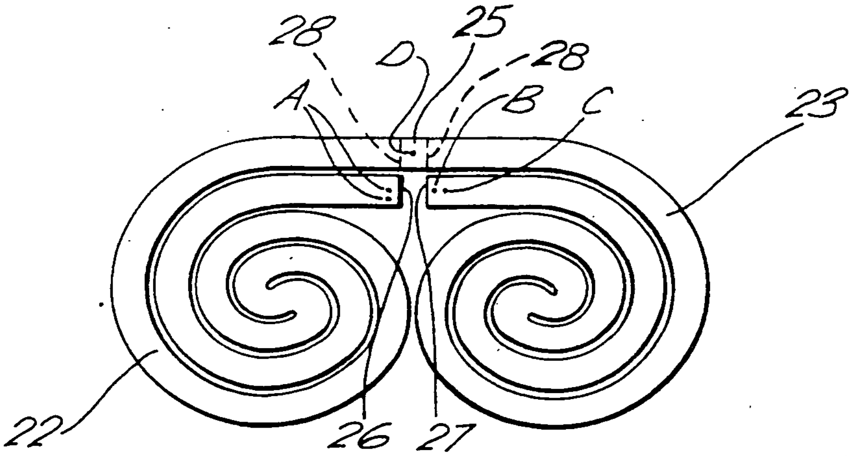


Fig. 4.



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Application number

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EUROPEAN SEARCH REPORT

EP 84 30 3370

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	GB-A-2 109 937 (QUAYLE et al.) * Page 2, lines 57-69 *	1	G 01 N 17/00
A	* Page 1, line 64 - page 2, line 93 *	2-5,7	

A	US-A-3 996 124 (EATON et al.) * Column 4, line 64 - column 7, line 35 *	1,6,11	

A	US-A-3 980 542 (WINSLOW, Jr. et al.) * Figure 1; column 3, line 34 - column 5, line 65 *	1,5,6, 11	
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A	US-A-4 326 164 (VICTOR) * Column 3, lines 6-59 *	1	G 01 N 17/00

A	US-A-3 857 094 (CALDECOURT) * Column 1, line 65 - column 2, line 61 *	1,5,7, 10	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24-01-1985	BINDON C.A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly rel vant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or aft r the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document